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Mark Scheme (Results)

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Pearson BTEC Nationals
In Applied Science (31627H1P)
Unit 5: Principles and Applications of Science II - Physics

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Unit 5: Principles and Applications of Science II

General marking guidance

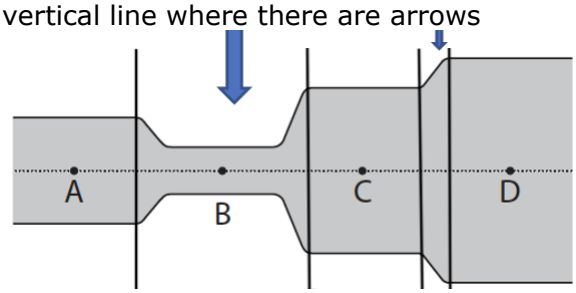
- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme

Question Number	Answer	Additional guidance	Mark
1 (a)	Any **two** from: chaotic (flow) (1) speed of water constantly changing (1) creates eddies/eddy currents (1) streamlines cross or mix (1) increased viscous drag (1)	 allow random/rough/not smooth/not laminar (flow) /different directions allow different speeds allow vortices/swirls allow (water layers) cross/mix layers intercept each other/broken streamlines allow high/increase drag or friction (between layers) allow a diagram showing eddies and mixing for both marks ignore references to viscosity/density/pressure/force	2
1 (b)(i)	B		1
1 (b)(ii)	D		1
1 (b)(iii)	an X in the section of the pipe where the pipe narrows, on or between the black vertical line where there are arrows  	the X may be inside or outside the diagram in the appropriate section the centre of the X must be either within or on the vertical lines shown.	1
1 (b)(iv)	arrow drawn on the diagram in the opposite direction to and parallel to the direction of water flow	arrow must be parallel by eye to the flow the arrow may be inside or outside the diagram	1

1 (c)	Award **one** mark for an identification and **two** additional marks for an appropriate expansion. Identification (it/viscosity) is reduced (1) Expansion Any **two** from increased/high temperature (1) (which means that) the (honey) molecules {gain (kinetic) energy/move faster} (1) this enables molecules to overcome forces of attraction (between molecules) (1) which {reduces the friction between the liquid layers/ (allows the) particles slide past each other more easily} (1)	 allow (honey) thinner/runnier ignore hotter/warmer accept particles for molecules accept increase/have more (kinetic) energy accept intermolecular forces reduced/bonds loosen	3
		Total	**9 marks**

Question Number	Answer	Additional guidance	Mark
2 (a)	45 000 (W)	accept 45,000 or 45’000 or 45000 or 4.5×10^4, 45×10^3	1
2 (b)(i)	conversion (1) 0.5 km = 500m substitution (1) W = 12 500 x 500 evaluation (1) 6 250 000 (J)	allow full marks for 6250000 without working reject 6 000 000 accept 6250, 25, 0.04 for 2 marks accept 25000, 0.00004 for 1 mark	3

2 (b)(ii)	substitution (1) $0.85 = \frac{6\,250\,000}{\text{work input}}$ rearrangement (1) $\frac{6\,250\,000}{0.85} = \text{work input}$ evaluation (1) 7 400 000 (J) If 6 000 000 is used from Q2bi 7 100 000 (J)	allow substitution and rearrangement in either order allow ecf from Q2bi for output energy accept answers rounding to 7 400 000 accept answers rounding to 7 100 000 accept any correct value in MJ, kJ etc. accept 5 300 000, 1.36 x10^{-7} when using 6 250 000 for 2 marks accept 5 100 000, 1.41 x10^{-7} when using 6 000 000 for 2 marks allow full marks for correct answer without working	3
		Total	**7 marks**

Question Number	Answer	Additional guidance	Mark
3 (a)(i)	D (thermal capacity)		1
3 (a)(ii)	(the olive oil and the thermometer have reached) thermal equilibrium (1) AND because there is no net energy transfer (between the two) (1) OR (thermal) energy transfer from thermometer to liquid equals (thermal) energy transfer from liquid to thermometer (1)	accept temperature equilibrium/they are in equilibrium allow heat for (thermal) energy ignore reaching room temperature	2

3 (b)(i)	**Before freezing:** Any **two** from: molecules moving {randomly/sliding over/ around} each other (1) {irregular/random} arrangement (1) weak(er) forces/bonds between the molecules (1) **After freezing:** Any **two** from: molecules are in fixed positions/only vibrate (1) {tightly/closely} packed OR regular {arrangement/lattice} (1) molecules closer together/smaller spacing between molecules (1) strong(er) forces/bonds between the molecules (1)	accept particles for molecules ignore 'moving freely/'move a little' ignore 'fixed structure' comparison required accept (well labelled) diagrams	4

3 (b)(ii)	Conversion (1) 500 g = 0.5 kg Substitution. (1) Q= 0.5 x 267 000 Division (1) $\frac{133500}{200}$ Evaluation (1) 668 (s) or 11mins 8 seconds	 133 500 (J) 133500000 if 500 g used 1 mark if seen, award 3 marks: $\frac{0.5 \times 267\,000}{200}$ accept 667.5(s) or answer rounding to 670 (s) answers rounding to 670 with a POT gain 3 marks 26.7×10^{7} and 0.00149 gains 3 marks incorrect final rearrangement 2.67×10^{10} and 0.00000149 gain 2 marks no conversion and incorrect final rearrangement for inverting the final answer.	4
		Total	**11 marks**

Question Number	Answer	Additional guidance	Mark
4 (a)	C (malleability)		1
4 (b)	Any two from (stretching the band) transfers (Kinetic)energy to the (rubber) band (molecules) (1) energy is needed to stretch/straighten the (rubber) band (molecules) (1) this energy is stored as thermal energy (which increases the temperature) (1)	allow use of particles for molecules allow energy of the(rubber) band increases or work done on rubber band ignore references to friction accept unwinding the molecules/change the volume of the band ignore separation of molecules/particles allow transferred to thermal energy/heat energy	2

Question number	Indicative content
4 (c)(i)	**Steel** is strong in both tension and compression can withstand a greater stress with little strain is a ductile material yields/deflects before failure can be assembled rapidly is expensive compared to concrete can corrode/rust in poor weather conditions is very heavy/dense, this limits length of beams can be used inside concrete as reinforcement to make concrete stronger **Concrete** is very strong in compression is much cheaper than steel is less dense so can build large structures can be easily moulded to fit the space exactly is brittle/will suddenly break is weaker and will undergo a greater strain for a smaller stress takes time to dry so longer construction time needed takes time to achieve full strength less susceptible to corrosion/external weathering

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
	0	No awardable content.
Level 1 **Pass**	1–2	• Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made. • Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported. • The discussion shows some structure and coherence.
Level 2 **Merit**	3–4	• Good analysis, interpretation and/or evaluation of the scientific information. • Lines of argument mostly supported through the application of relevant evidence. • The discussion shows a structure which is mostly clear, coherent and logical.
Level 3 **Distinction**	5–6	• Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence. • The discussion shows a well-developed structure which is clear, coherent, and logical.

Question Number	Answer	Additional guidance	Mark
4 (c)(ii)	Conversion (1) 5 mm = 0.005 m Substitution (1) $2 \times (10^{10}) = \frac{F \times 10}{3 \times (10^{-4}) \times (0.00)5}$ Rearrangement (1) $(F=) \frac{3 \times (10^{-4}) \times (0.00)5 \times 2 \times (10^{10})}{10}$ Evaluation (1) 3000 (N) or 3×10^{3} (N)	allow substitution and rearrangement in either order independent mark $2 = \frac{Fx10}{3 \times 5.}$ or $\frac{F \times 10}{15}$ 1 mark $(F=) \frac{3x\ 5\ x2}{10} = \frac{30}{10}$ 2 marks $F=\frac{EA\ \Delta x}{L}$ gains rearrangement allow 3×10^{6} or 3 000 000 for 3 marks where 5mm rather than 0.005m is used allow full marks for correct answer without working	4
		Total	**13 marks**

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